UNIT - III

COMPRESSION MEMBERS

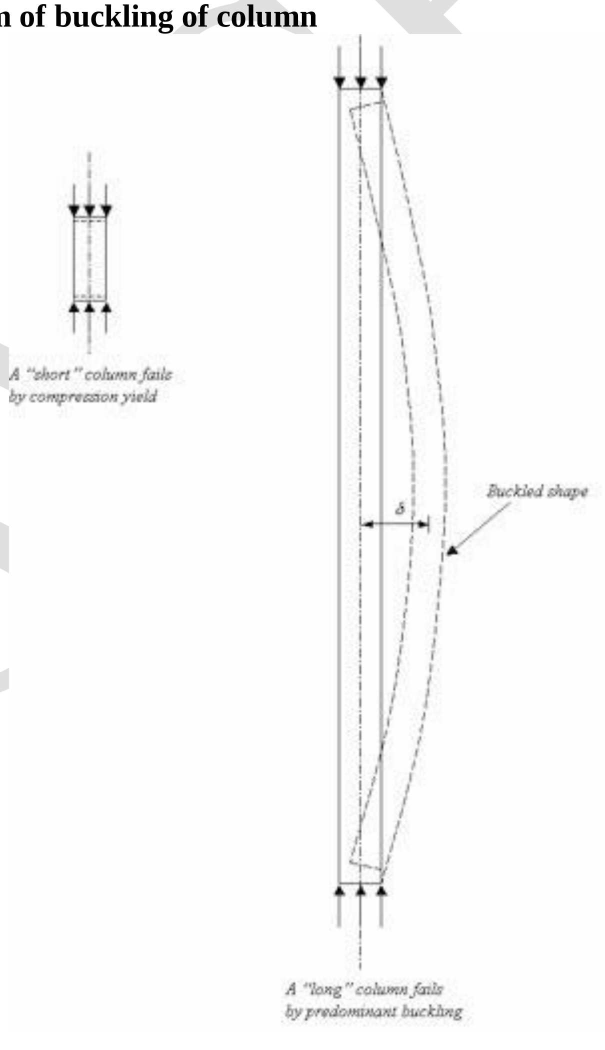
Types of compression members – Theory of columns – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base

PART – A
TWO MARK QUESTIONS AND ANSWERS

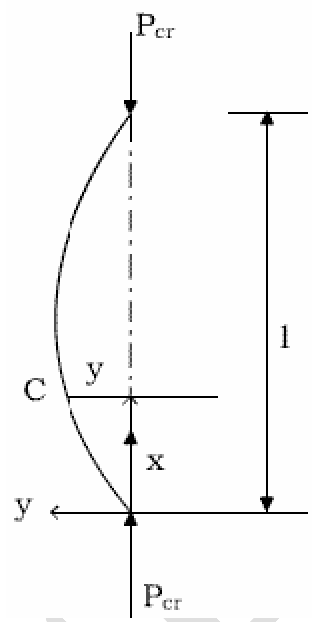
1.What is meant by short strut?

If the strut is "short", the applied forces will cause a compressive strain, which results in the shortening of the strut in the direction of the applied forces.

2. Draw the diagram of buckling of column



3.What are the assumptions made in Euler's analysis?



1.The material is homogeneous and linearly elastic (i.e. it obeys Hooke's Law).

2 The strut is perfectly straight and there are no imperfections.

3.The loading is applied at the centroid of the cross section at the ends.

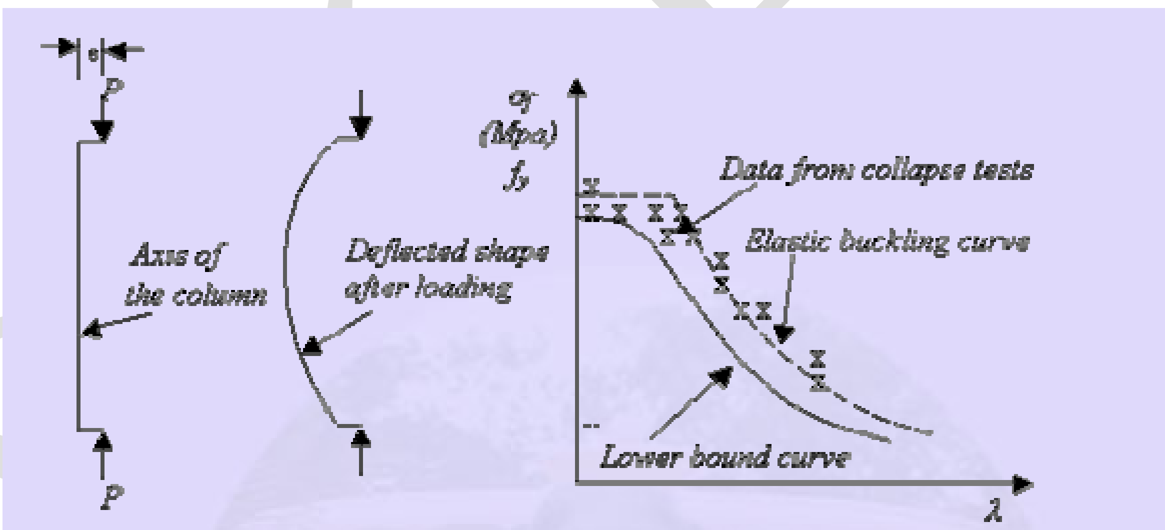
4. What are the effect of strain hardening and the absence of clearly defined yield point?

If the material of the column shows strain hardening after a yield platen, the onset of first yield will not be affected, but the collapse load may be increased. Designers tend to ignore the effect of strain hardening which in fact provides an additional margin of safety.

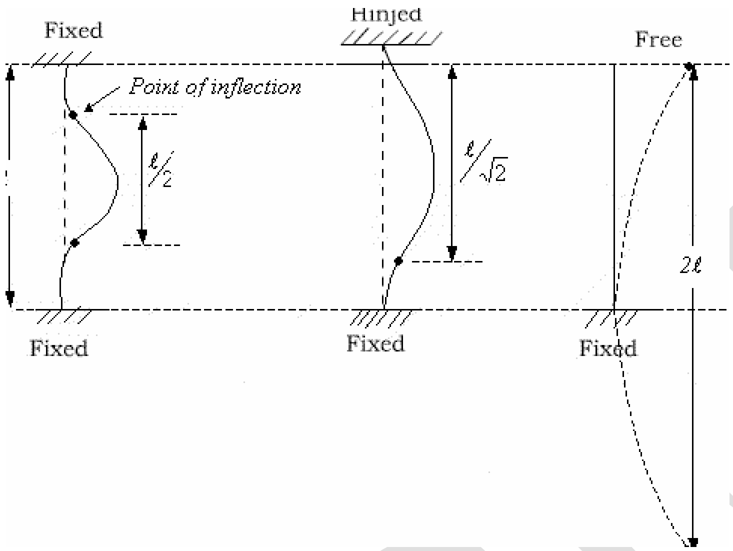
High strength steels generally have stress-strain curves without a clear yield point. At stresses above the limit of proportionality (*fp)*, the material behaviour is non-linear and on unloading and reloading the material is linear-elastic. Most high strength structural steels have an ultimate stress beyond which the curve becomes more or less horizontal.

5. Write the effect of eccentricity of applied loading

As has already been pointed out, it is impossible to ensure that the load is applied at the exact centroid of the column. Fig. shows a straight column with a small eccentricity (e) in the applied loading. The applied load (P) induces a bending moment (P.e) at every cross section. This would cause the column to deflect laterally,in a manner similar to the initially deformed member discussed previously. Once againthe greatest compressive stress will occur at the concave face of the column at a section midway along its length. The load-deflection response for purely elastic andelastic-plastic behaviour is similar to those described in Fig. except that the
deflection is zero at zero load.



6. What are the buckled modes for different end conditions?



7. What are the different effective lengths for different boundary condition?

Boundary conditions	Theory	Code value
Both ends pin ended	1.0L	1.0L
Both ends fixed	0.5L	0.65L
One end fixed and the other end pinned	0.707L	0.8L
One end fixed, and the other free to sway	1.2L	1.2L
One end fixed and the other end free	2.0L	2.0L

8. What is meant by flexural buckling and torsional –flexural buckling?

When the strut buckles b jy bending in a plane of symmetry of the cross section, referred to as **"flexural buckling"**.

Singly symmetric or un-symmetric cross-sections may undergo combined twisting about the shear centre and a translate jon of the shear centre. This is known as **"torsional – flexural buckling"**.

9. What are Steps in the design of axially loaded columns?

The procedure for the design of an axially compressed column is as follows:

(i) Assume a suitable trial section and classify the section in accordance with the classification in chapter.

(ii) Arrive at the effective length of the column by suitably considering the end conditions.

(iii) Calculate the slenderness ratios (λ values) in both minor and major axes direction

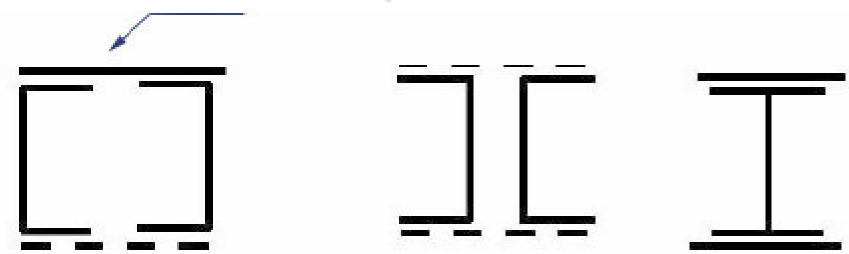
(iv) Calculate f_{cd} values along both major and minor axes

(v) Compute the load that the compression member can resist ($p_d=A_cf_{cd}$)

10. Write about batten plates compression member.

When compression members are required for large structures like bridges, it willbe necessary to use built-up sections. They are particularly useful when loads are heavy and members are long (e.g. top chords of Bridge Trusses). Built up sections [illustrated in Fig.] are popular in India when heavy loads are encountered.

The cross section consists of two channel sections connected on their open sides with some type of lacing or latticing (dotted lines) to hold the parts togetherand ensure that they act together as one unit. The ends of these members areconnected with “batten plates” which tie the ends together.



(a) Built-up Box section (b) Built-up Box section (c) Built-up I section

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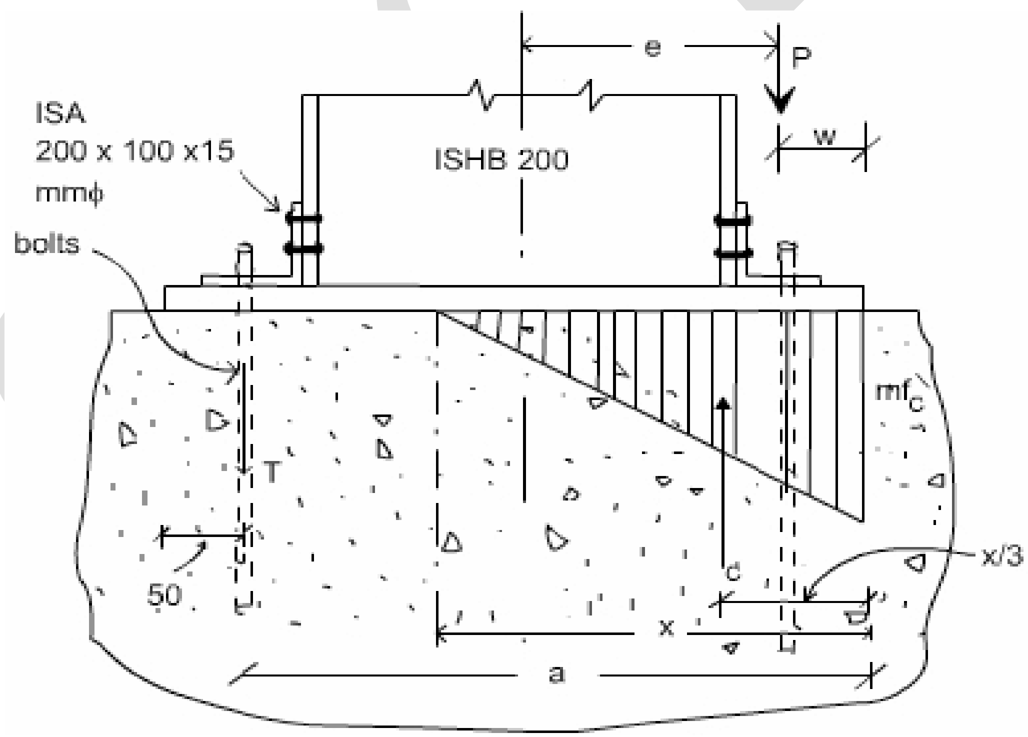
11. What are the three classifications for determination of size of plate?

Class I- will pertain to all base plates the moment on which is so small in proportion to the direct load that there is compression over the entire area between the bottom of the base and its foundation

Class II- will pertain a comparatively small range of base plates which have tension over a small portion - one - third or loss of the area

Class III- will include those which are exposed to a comparatively large moment and which therefore have tension over a large portion - more than one -third of the area between the bottom of the base plate and its concrete footing.

12. Draw the column base plate diagram



13. What is the purpose for providing anchors bolt in base plate?

Anchor bolts are provided to stabilize the column during erection and to prevent uplift for cases involving large moments. Anchor bolts can be cast-in place bolts or drilled-in bolts. The latter are placed after the concrete in set and are not too often used. Their design is governed by the manufacturer's specifications. Cast-in-place bolts are hooked bars, bolts, or threaded rods withnuts (figure) placed before the concrete is set.

PART - B

16 MARK QUESTIONS

1.design a rolled steel beam section column to carry an axial load 1100 KN. The column is 4 m long and adequately in position but not in direction at both ends.

2. A rolled steel beam section HB 350 @ 0.674 kN/m is used as a stanchion. If the unsupported length of the stanchion is 4 m, determine safe load carrying capacity of the section.

3. A double angle discontinuous strut ISA 125 mm * 95 * mm * 10 mm long legs back to back is connected to both sides of a gusset plate 10 mm thick with 2 rivets. The length of strut between centre to centre of intersections is 4 m. determine the safe load carrying capacity of the section.

4.A steel column 12 m long carries an axial load of 1000 kN. The column is hinged at both ends. Design an economical built-up section with double lacing. Design the lacing also.

5. Design a built-up column consisting of two channels connected by batten to carry an axial load of 800 KN; the effective length of the column is 6 m.

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PART – C

ASSIGNMENT QUESTIONS

1. Design a built up column 8m long to carry a load of 400kN. The column is restrained in position but not in direction at both the ends. Provide single angle lacing system with riveted connections. (Nov/Dec 2007)

2. Design a built up column 6m long to carry a load of 400kN. The column is provided with Batten system. The ends of the columns are pinned. Design the battens. (Nov/Dec 2007)

3. A discontinues strut consists of two ISA 90X75X10mm placed to the same side of a gusset plate 10mm thick with its longer leg back to back, with one rivet on each angle at the ends. The effective length of the strut is 2.5m. Determine the allowable load. What is the safe load if the strut is continuous? Take f_y = 250N/mm^2. The angles are connected with tack rivets along the length. (May/June 2007)

4. A built up column consists ISHB 400@ 77.40 kg/m with one 300mmX12mm flange plate on each side. The column carries an axial load of 2600kN. Design a gusseted base, if the column is supported on concrete pedestal with a bearing pressure of 5N/mm^2. (May/June 2007)

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